

## MOSFET

### 800V CoolMOS™ P7 Power Transistor

The latest 800V CoolMOS™ P7 series sets a new benchmark in 800V super junction technologies and combines best-in-class performance with state of the art ease-of-use, resulting from Infineon's over 18 years pioneering super junction technology innovation.

#### Features

- Best-in-class FOM  $R_{DS(on)} * E_{oss}$ ; reduced  $Q_g$ ,  $C_{iss}$ , and  $C_{oss}$
- Best-in-class DPAK  $R_{DS(on)}$
- Best-in-class  $V_{(GS)th}$  of 3V and smallest  $V_{(GS)th}$  variation of  $\pm 0.5V$
- Integrated Zener Diode ESD protection
- Best-in-class CoolMOS™ quality and reliability; qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)
- Fully optimized portfolio

#### Benefits

- Best-in-class performance
- Enabling higher power density designs, BOM savings and lower assembly costs
- Easy to drive and to parallel
- Better production yield by reducing ESD related failures
- Less production issues and reduced field returns
- Easy to select right parts for fine tuning of designs

#### Applications

Recommended for hard and soft switching flyback topologies for LED Lighting, low power Chargers and Adapters, Audio, AUX power and Industrial power. Also suitable for PFC stage in Consumer applications and Solar.

*Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.*



**Table 1 Key Performance Parameters**

Parameter	Value	Unit
$V_{DS} @ T_J=25^{\circ}C$	800	V
$R_{DS(on),max}$	0.45	$\Omega$
$Q_{g,typ}$	24	nC
$I_D$	11	A
$E_{oss} @ 500V$	2.7	$\mu J$
$V_{GS(th),typ}$	3	V
ESD class (HBM)	2	-

Type / Ordering Code	Package	Marking	Related Links
IPA80R450P7	PG-TO 220 FullPAK	80R450P7	see Appendix A

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## 1 Maximum ratings

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 2 Maximum ratings**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current <sup>1)</sup>	$I_D$	-	-	11 7.1	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	-	-	29	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	$E_{AS}$	-	-	29	mJ	$I_D=1.8\text{A}$ ; $V_{DD}=50\text{V}$
Avalanche energy, repetitive	$E_{AR}$	-	-	0.22	mJ	$I_D=1.8\text{A}$ ; $V_{DD}=50\text{V}$
Avalanche current, repetitive	$I_{AR}$	-	-	1.8	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	100	V/ns	$V_{DS}=0$ to 400V
Gate source voltage	$V_{GS}$	-20 -30	-	20 30	V	static; AC ( $f>1$ Hz)
Power dissipation	$P_{tot}$	-	-	29	W	$T_C=25^\circ\text{C}$
Operating and storage temperature	$T_j, T_{stg}$	-55	-	150	$^\circ\text{C}$	-
Mounting torque	-	-	-	50	Ncm	M2.5 screw
Continuous diode forward current	$I_S$	-	-	5	A	$T_C=25^\circ\text{C}$
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$	-	-	29	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt <sup>3)</sup>	dv/dt	-	-	1	V/ns	$V_{DS}=0$ to 400V, $I_{SD}\leq 2.2\text{A}$ , $T_j=25^\circ\text{C}$
Maximum diode commutation speed <sup>3)</sup>	di/dt	-	-	50	A/ $\mu\text{s}$	$V_{DS}=0$ to 400V, $I_{SD}\leq 2.2\text{A}$ , $T_j=25^\circ\text{C}$
Insulation withstand voltage	$V_{ISO}$	-	-	2500	V	$V_{rms}$ , $T_C=25^\circ\text{C}$ , $t=1\text{min}$

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	4.4	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	80	$^\circ\text{C/W}$	leaded
Thermal resistance, junction - ambient for SMD version	$R_{thJA}$	-	-	-	$^\circ\text{C/W}$	n.a.
Soldering temperature, wavesoldering only allowed at leads	$T_{sold}$	-	-	260	$^\circ\text{C}$	1.6 mm (0.063 in.) from case for 10s

<sup>1)</sup> TO220 equivalent. Limited by  $T_{j,max}$ . Maximum duty cycle  $D=0.5$

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup>  $V_{DClink}=400\text{V}$ ;  $V_{DS,peak}<V_{(BR)DSS}$ ; identical low side and high side switch with identical  $R_G$ ;  $t_{cond}<2\mu\text{s}$

### 3 Electrical characteristics

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 4 Static characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	800	-	-	V	$V_{GS}=0V, I_D=1mA$
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5	V	$V_{DS}=V_{GS}, I_D=0.22mA$
Zero gate voltage drain current	$I_{DSS}$	-	-	1	$\mu A$	$V_{DS}=800V, V_{GS}=0V, T_j=25^\circ C$ $V_{DS}=800V, V_{GS}=0V, T_j=150^\circ C$
Gate-source leakage current incl. zener diode	$I_{GSS}$	-	-	1	$\mu A$	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.38	0.45	$\Omega$	$V_{GS}=10V, I_D=4.5A, T_j=25^\circ C$ $V_{GS}=10V, I_D=4.5A, T_j=150^\circ C$
Gate resistance	$R_G$	-	1	-	$\Omega$	$f=250kHz, \text{open drain}$

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$	-	770	-	pF	$V_{GS}=0V, V_{DS}=500V, f=250kHz$
Output capacitance	$C_{oss}$	-	14	-	pF	$V_{GS}=0V, V_{DS}=500V, f=250kHz$
Effective output capacitance, energy related <sup>1)</sup>	$C_{o(er)}$	-	24	-	pF	$V_{GS}=0V, V_{DS}=0 \text{ to } 500V$
Effective output capacitance, time related <sup>2)</sup>	$C_{o(tr)}$	-	305	-	pF	$I_D=\text{constant}, V_{GS}=0V, V_{DS}=0 \text{ to } 500V$
Turn-on delay time	$t_{d(on)}$	-	10	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=4.5A, R_G=7.5\Omega$
Rise time	$t_r$	-	6	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=4.5A, R_G=7.5\Omega$
Turn-off delay time	$t_{d(off)}$	-	40	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=4.5A, R_G=7.5\Omega$
Fall time	$t_f$	-	10	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=4.5A, R_G=7.5\Omega$

**Table 6 Gate charge characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$	-	4	-	nC	$V_{DD}=640V, I_D=4.5A, V_{GS}=0 \text{ to } 10V$
Gate to drain charge	$Q_{gd}$	-	9	-	nC	$V_{DD}=640V, I_D=4.5A, V_{GS}=0 \text{ to } 10V$
Gate charge total	$Q_g$	-	24	-	nC	$V_{DD}=640V, I_D=4.5A, V_{GS}=0 \text{ to } 10V$
Gate plateau voltage	$V_{plateau}$	-	4.5	-	V	$V_{DD}=640V, I_D=4.5A, V_{GS}=0 \text{ to } 10V$

<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 500V

<sup>2)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 500V

**Table 7 Reverse diode characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	$V_{SD}$	-	0.9	-	V	$V_{GS}=0V, I_F=4.5A, T_i=25^\circ C$
Reverse recovery time	$t_{rr}$	-	1000	-	ns	$V_R=400V, I_F=2.2A, di_F/dt=50A/\mu s$
Reverse recovery charge	$Q_{rr}$	-	11	-	$\mu C$	$V_R=400V, I_F=2.2A, di_F/dt=50A/\mu s$
Peak reverse recovery current	$I_{rrm}$	-	17	-	A	$V_R=400V, I_F=2.2A, di_F/dt=50A/\mu s$

## 4 Electrical characteristics diagrams

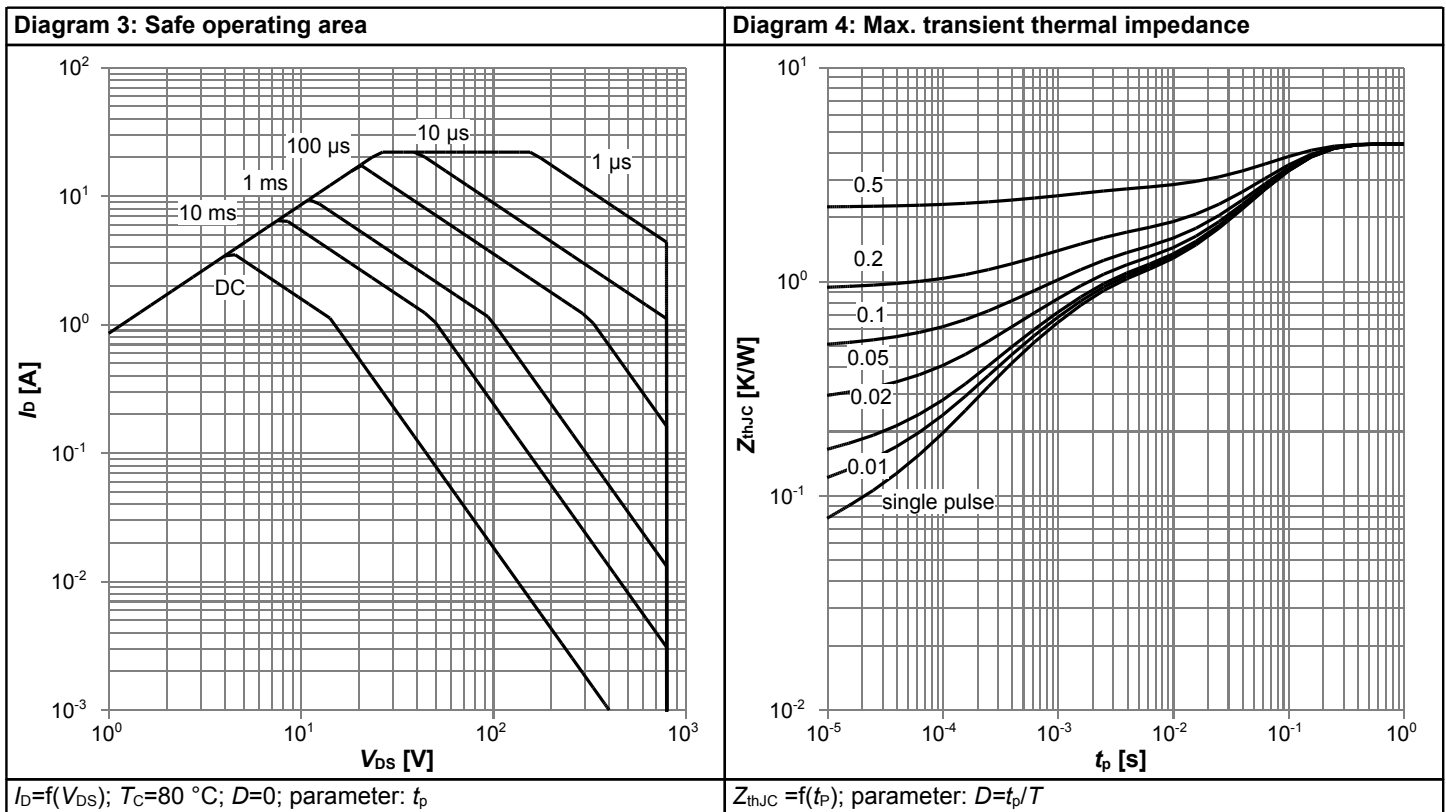
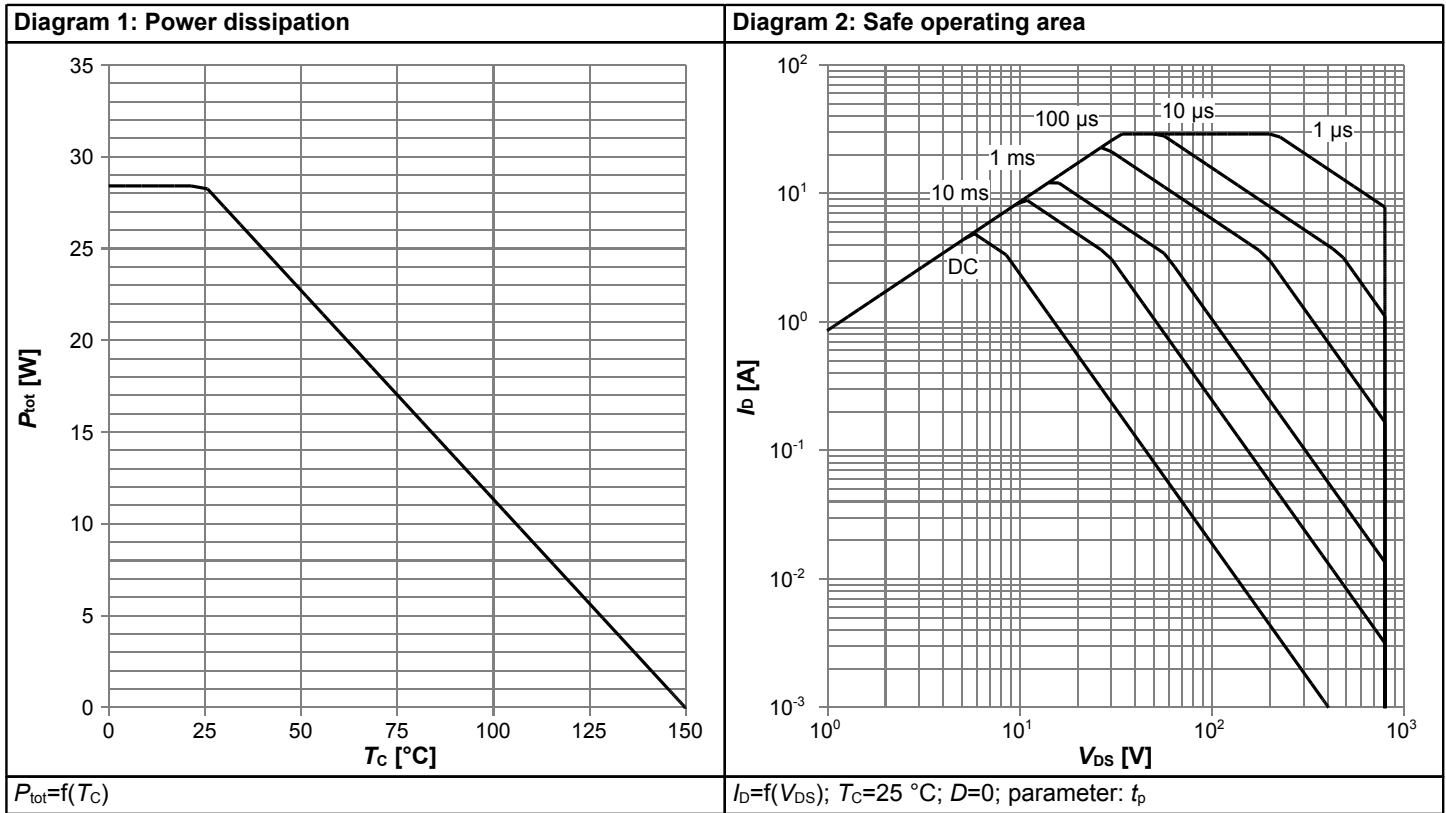
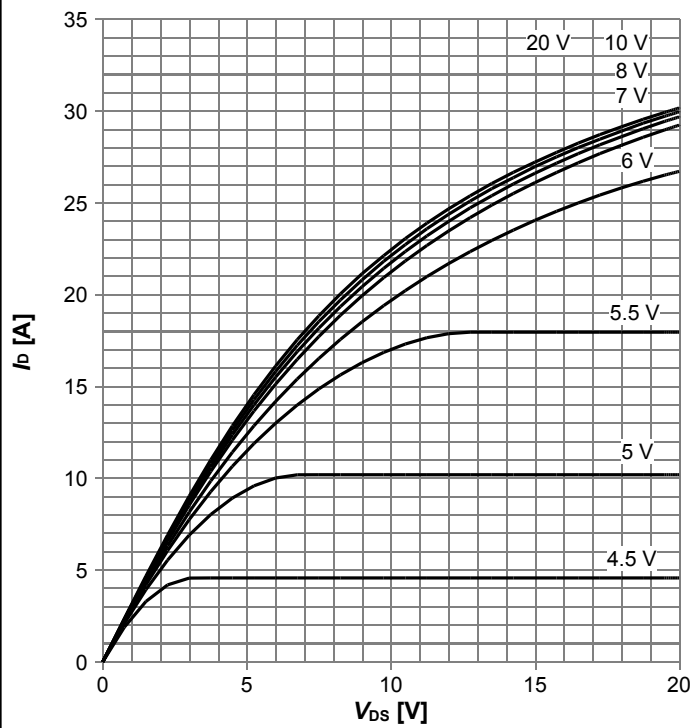
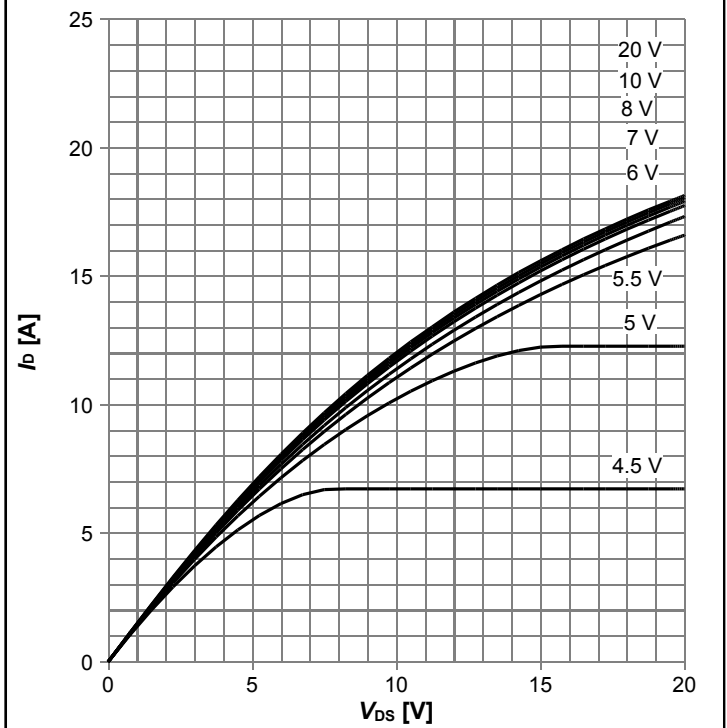


Diagram 5: Typ. output characteristics



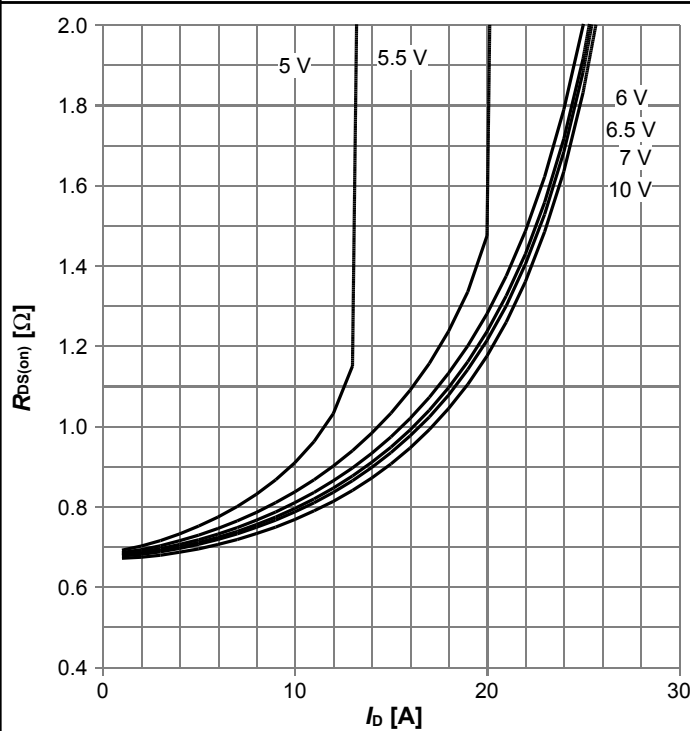
$I_D=f(V_{DS})$ ;  $T_j=25\text{ }^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



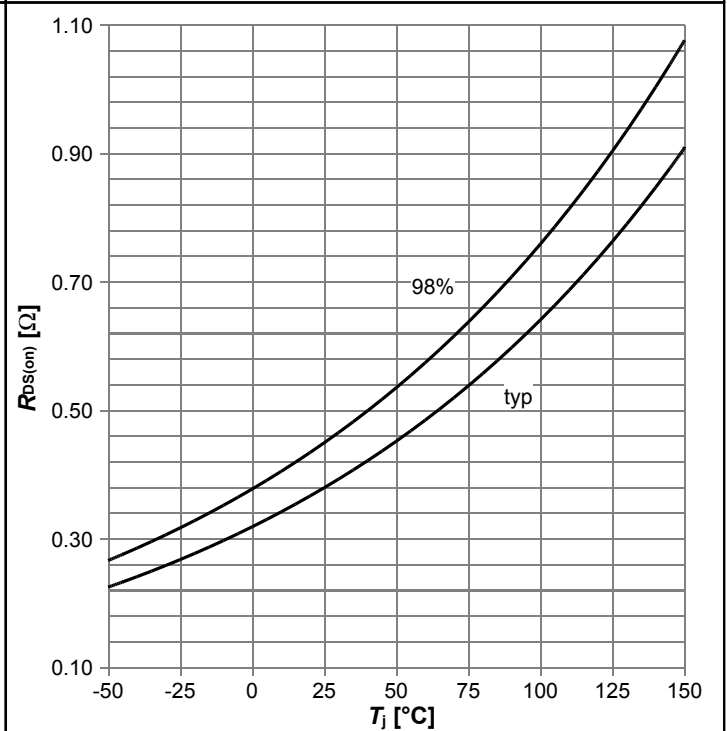
$I_D=f(V_{DS})$ ;  $T_j=125\text{ }^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. drain-source on-state resistance



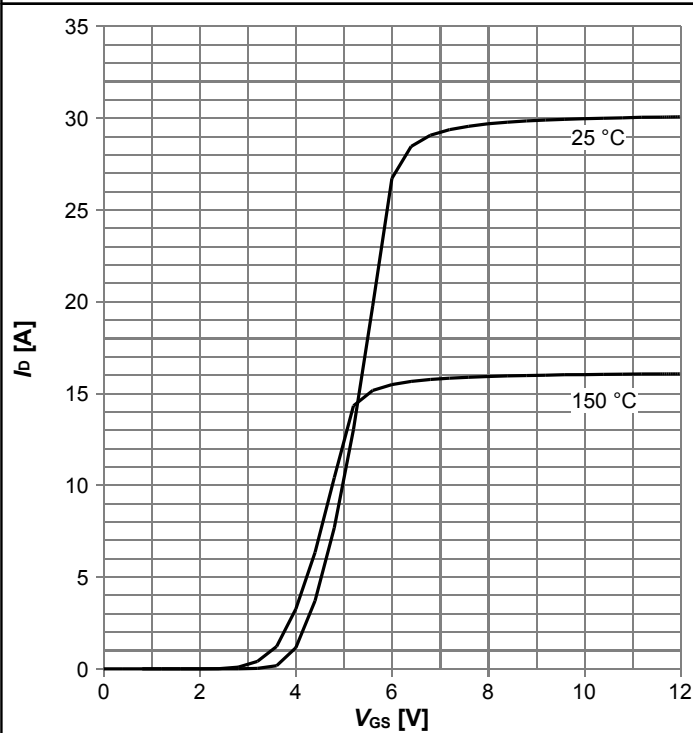
$R_{DS(on)}=f(I_D)$ ;  $T_j=125\text{ }^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 8: Drain-source on-state resistance



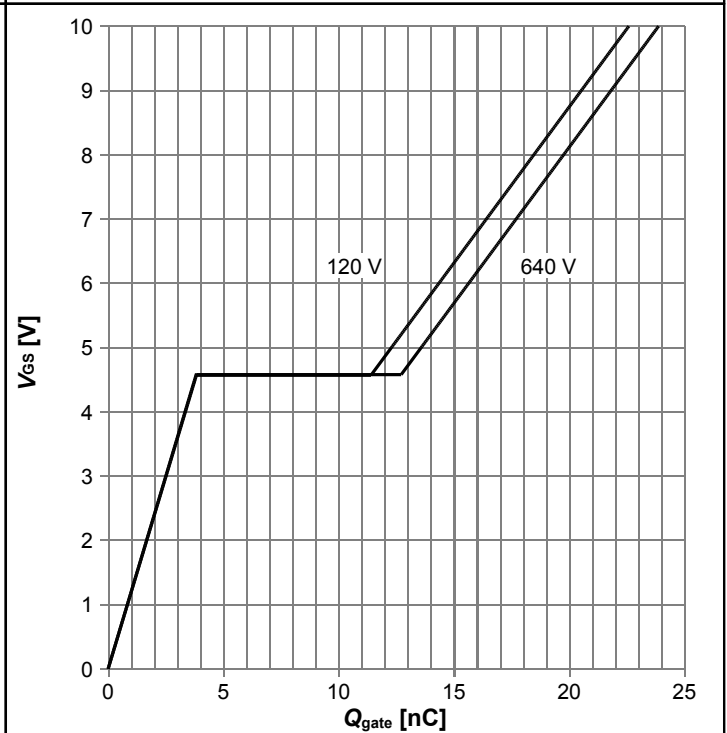
$R_{DS(on)}=f(T_j)$ ;  $I_D=4.5\text{ A}$ ;  $V_{GS}=10\text{ V}$

Diagram 9: Typ. transfer characteristics



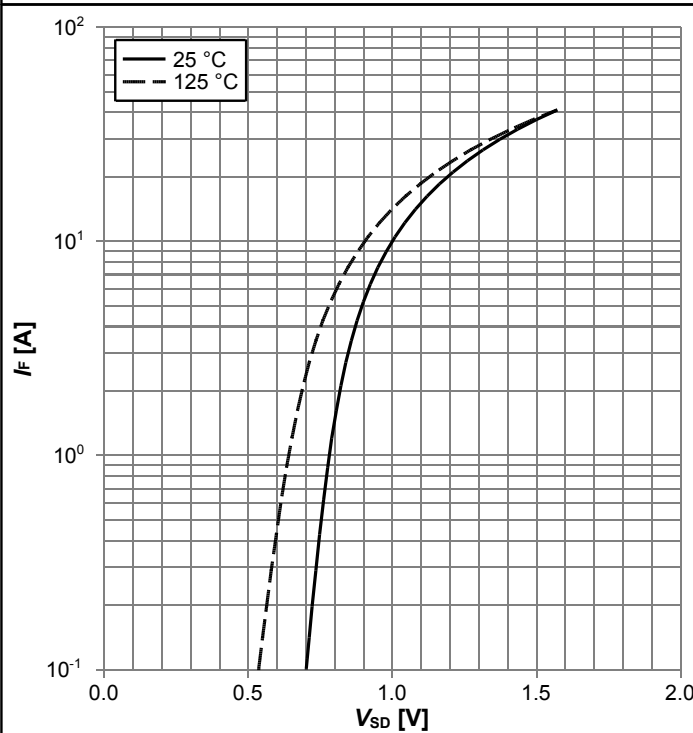
$I_D = f(V_{GS})$ ;  $V_{DS} = 20V$ ; parameter:  $T_j$

Diagram 10: Typ. gate charge



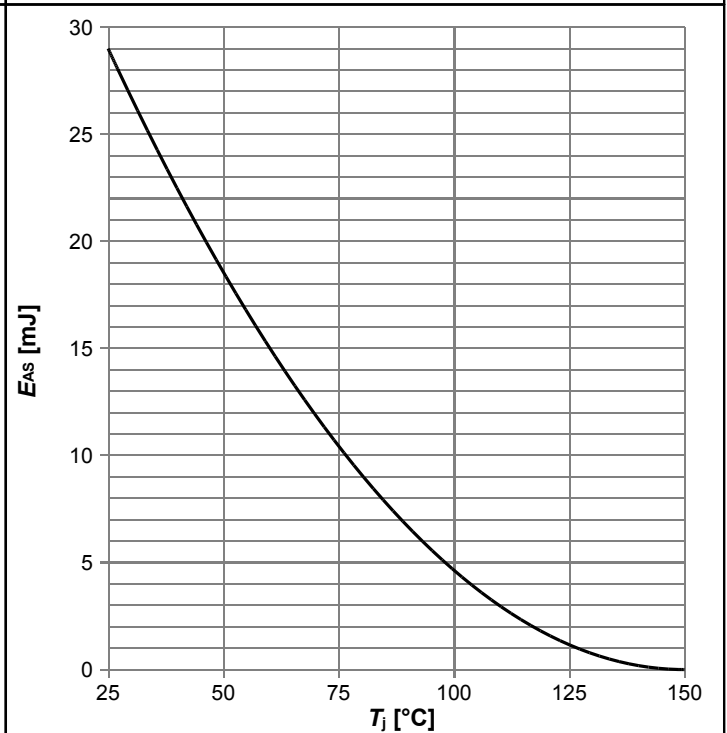
$V_{GS} = f(Q_{gate})$ ;  $I_D = 4.5 A$  pulsed; parameter:  $V_{DD}$

Diagram 11: Forward characteristics of reverse diode



$I_F = f(V_{SD})$ ; parameter:  $T_j$

Diagram 12: Avalanche energy



$E_{AS} = f(T_j)$ ;  $I_D = 1.8 A$ ;  $V_{DD} = 50 V$

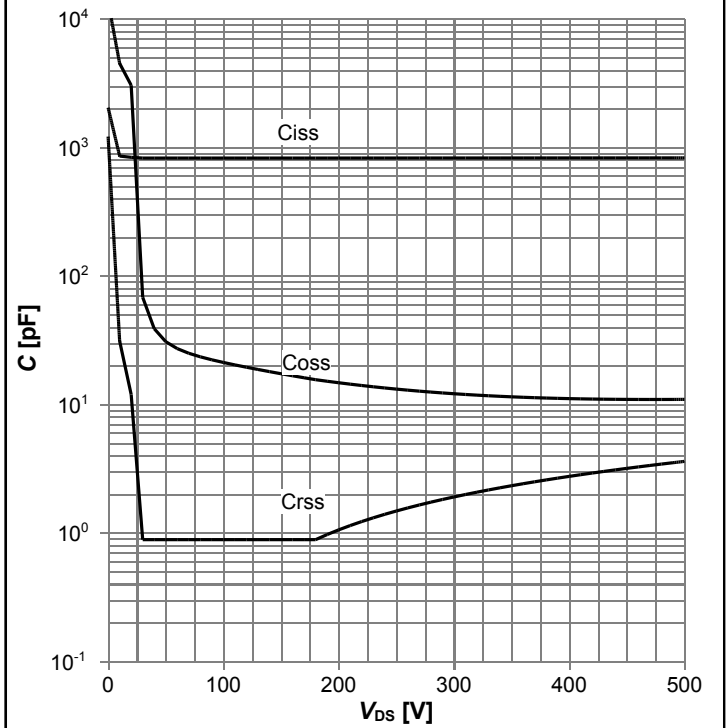


Diagram 13: Drain-source breakdown voltage



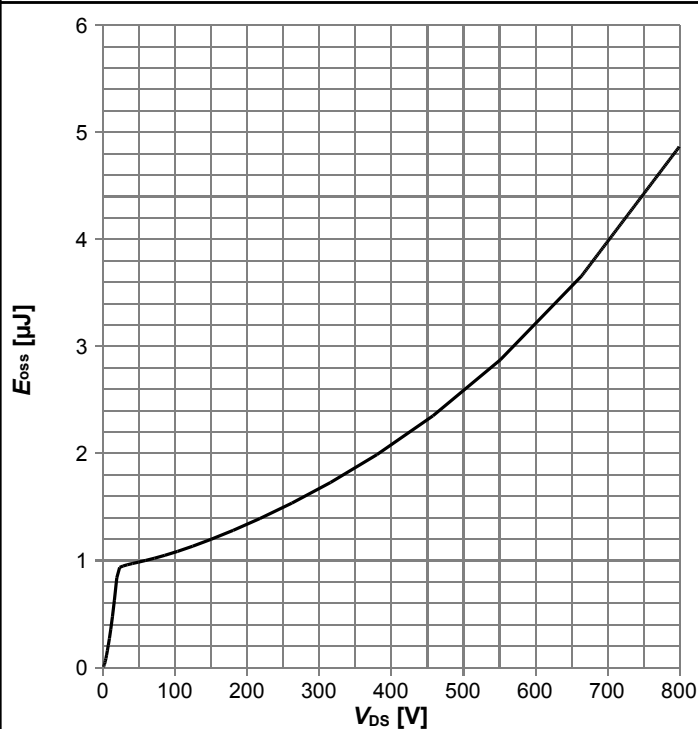
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram 14: Typ. capacitances



$C=f(V_{DS}); V_{GS}=0 \text{ V}; f=250 \text{ kHz}$

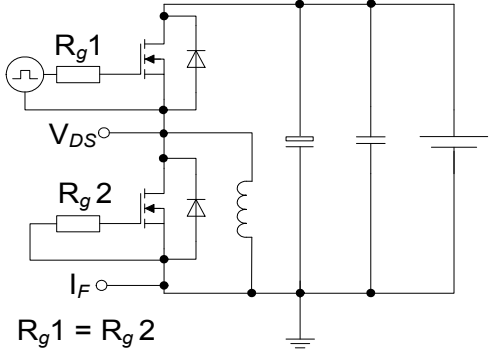
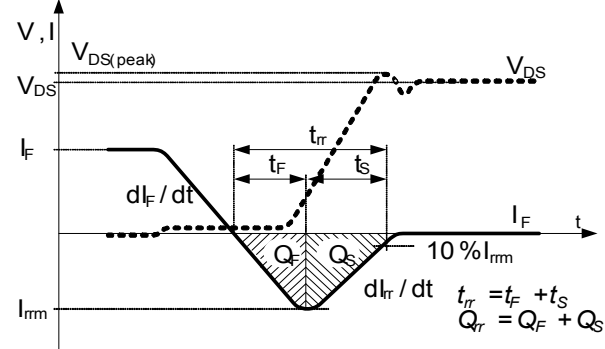
Diagram 15: Typ. Coss stored energy



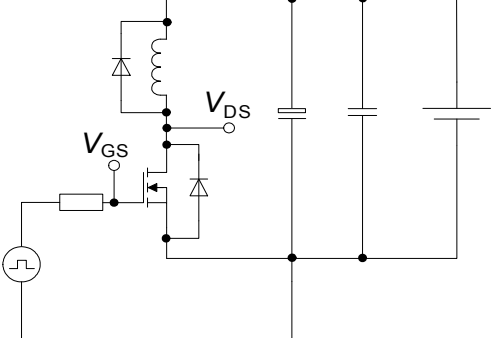
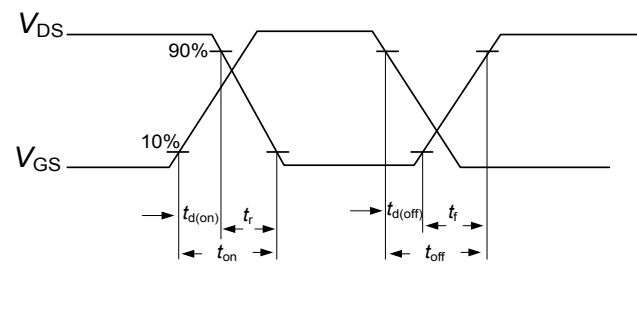
$E_{oss}=f(V_{DS})$

## 5 Test Circuits

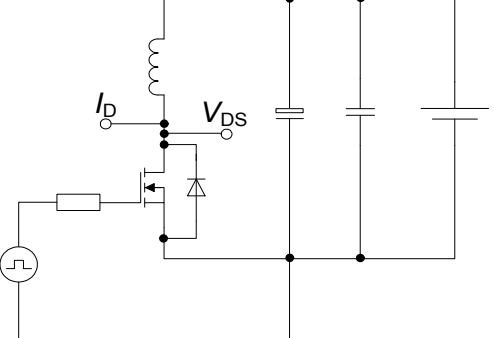
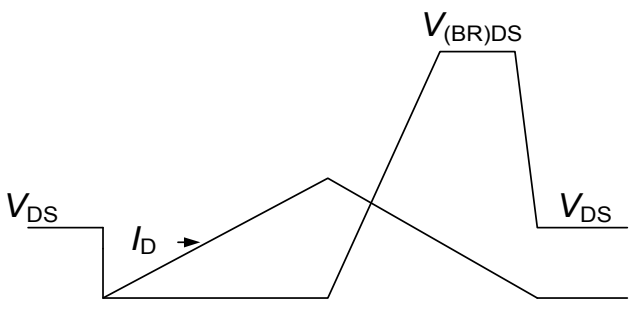
**Table 8 Diode characteristics**

Test circuit for diode characteristics	Diode recovery waveform
 <p><math>R_{g1} = R_{g2}</math></p>	 <p><math>t_{rr} = t_r + t_s</math>  <math>Q_{rr} = Q_F + Q_S</math></p>

**Table 9 Switching times**

Switching times test circuit for inductive load	Switching times waveform
	

**Table 10 Unclamped inductive load**

Unclamped inductive load test circuit	Unclamped inductive waveform
	 <p><math>V_{(BR)DS}</math></p>

## 6 Package Outlines



- NOTES:
1. INDUSTRIAL QUALITY GRADE
  2. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-281 NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS

DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.50	4.90	0.177	0.193
A1	2.34	2.85	0.092	0.112
A2	2.42	2.86	0.095	0.113
b	0.65	0.90	0.026	0.035
b1	0.95	1.38	0.037	0.054
b2	0.95	1.51	0.037	0.059
b3	0.65	1.38	0.026	0.054
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.67	16.15	0.617	0.636
D1	8.97	9.83	0.353	0.387
E	10.00	10.65	0.394	0.419
e	2.54 (BSC)		0.100 (BSC)	
e1	5.08		0.200	
N	3		3	
H	28.70	29.75	1.130	1.171
L	12.78	13.75	0.503	0.541
L1	2.83	3.45	0.111	0.136
øP	2.95	3.38	0.116	0.133
Q	3.15	3.50	0.124	0.138

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**Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches**

## 7 Appendix A

### Table 11 Related Links

- IFX CoolMOS Webpage: [www.infineon.com](http://www.infineon.com)
- IFX Design tools: [www.infineon.com](http://www.infineon.com)

# 800V CoolMOS™ P7 Power Transistor

## IPA80R450P7

### Revision History

IPA80R450P7

**Revision: 2016-07-05, Rev. 2.0**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2016-07-05	Release of final version

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